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**IS : 1991 ( Part 10 ) - 1987**

*Indian Standard* ( Reaffirmed 2002 )

# SAFETY REQUIREMENTS FOR THE USE, CARE AND PROTECTION OF ABRASIVE GRINDING WHEELS

## PART 10 MOUNTED WHEELS

## *( Second Revision )*

Abrasives Sectional Committee, EDC 13; Grinding Wheels Subcommittee, EDC 13 : 1 [ Ref : Doc : EDC 13 ( 4722 ) ]

**1. Scope** — This Standard ( Part 10 ) deals with the requirements for the mounted wheels.

**2. Maximum Safe Operating Speeds** — The maximum safe operating speed for mounted wheels shall be determined by the following factors:

a) Shape and size of the mounted wheel [ *see* IS : 3300-1980 Dimensions for mounted wheels and points ( *first revision* ) ],'
b) Size of mandrel,
c) Overhang of mandrel ( *see* Fig. 1 ), and
d) Wheel specifications.

The marking symbols will normally indicate the type of abrasive, abrasive size, grade of hardness and the bond employed. The maximum operating speed is shown in revolutions per minute.

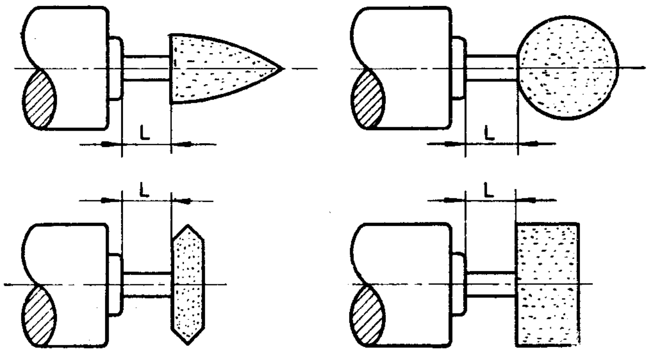

FIG. 1 OVERHANG IN MOUNTED WHEELS

**2.1** Taking the first three factors into consideration, the maximum safe operating speed shall be looked up in the corresponding table from Tables 1 to 5. ( The overhangs indicated are for unthreaded mandrels ). Threaded mandrels will take the same speeds as the 13 mm overhang unthreaded mandrel.

Maximum operating speeds for mounted wheels are generally limited by the size and shape of the wheel, the mandrel material and diameter, and the distance from the mounting chuck to the abrasive body ( overhang ).

Due to the size of some mounted wheels, it is necessary to reduce the size of the mandrel where it enters the wheel. These are called tapered mandrels. It will be noted, however, that the resistance to bending or whipping due to speed is dependent on the size of the mandrel at the point where it is chucked so that the size of the mandrel for speed purposes will be the diameter of the chucked section.

As threading reduces the effective diameter of the mandrel, mounted wheels with threaded mandrels require lower operating speeds than the same size unthreaded mandrels. Because these mandrels are usually short and held closely in the chuck, the tables give only the speeds for 13 mm overhang.

Tables given in this standard indicate the maximum operating speeds for various standard mounted wheels in combination with several standard mandrel sizes and various overhangs. For many common combinations, the maximum operating speeds can be read directly from the tables. For Intermediate wheel and mandrel sizes and overhangs not shown, the maximum operating speed can be determined by interpolation.

If it is found that the desired combination of conditions would result in operation beyond the maximum speed, a slight change in any one of the following conditions may be all that is necessary to eliminate the danger of operating over the maximum speed. Such corrective steps are:

a) For a given shape, reducing the size of the wheel ( either diameter of thickness, or both ) will raise the maximum speed;
b) Increasing the diameter of the mandrel will raise the maximum speed; and
c) Reducing the overhang ( pushing the mandrel back into the chuck ) will raise the maximum speed.

Adopted 23 November 1987 © June 1989, BIS Gr 4

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*Exception*

> Tables 1 to 5 have been established to cover most mounted wheel specifications. Where these tables are not applicable, the mounted wheel manufacturer shall designate the maximum operating speed. In no case shall this maximum operating speed be exceeded, for the overhang to be used.

**2.2** *Special Maximum Operation Speed ( Strength of the Wheel )* — Table 6 shows the maximum operating speeds for various diameters of mounted wheels. This speed shall not be exceeded even though higher speeds and the maximum safe operating speeds are used under the exception in **2.1**. These speeds are based on the strength of vitrified, resinoid and rubber-mounted wheels of average grade.

**2.2.1** If for any special reason, it is necessary to use wheels coarser than 60 grit or of unusually soft grit, the maximum speed recommended by the wheel manufacturer shall not be exceeded.

**TABLE 1 MAXIMUM OPERATING SPEEDS FOR 3 mm MANDRELS FOR GROUP W PLAIN WHEELS**

( *Clause* 2.1 and Fig. 1 )

| **Shape No.** | **Wheel Diameter** mm | **Wheel Thickness** mm | **13 mm Overhang and Threaded Mandrels** | **25 mm Overhang** | **40 mm Overhang** | **50 mm Overhang** | **63 mm Overhang** |
|---|---|---|---|---|---|---|---|
| | | | Maximum Operating Speed, m/s | | | | |
| 144 | 3 | 6 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 145 | 3 | 10 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 146 | 3 | 13 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 149 | 4 | 6 | | | | | |
| 152 | 5 | 6 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 153 | 5 | 10 | 80 850 | 52 500 | 37 500 | 26 250 | 17 620 |
| 160 | 6 | 6 | 81 370 | 51 000 | 34 120 | 24 000 | 16 870 |
| 162 | 6 | 10 | 68 400 | 42 370 | 28 870 | 20 850 | 15 000 |
| 163 | 6 | 13 | 60 000 | 38 020 | 26 250 | 18 750 | 13 870 |
| 164 | 6 | 20 | 45 900 | 30 000 | 21 750 | 15 900 | 11 850 |
| 174 | 10 | 6 | 69 000 | 41 250 | 27 750 | 20 400 | 15 000 |
| 175 | 10 | 10 | 54 000 | 33 000 | 24 150 | 18 000 | 13 500 |
| 176 | 10 | 13 | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 177 | 10 | 20 | 33 750 | 23 250 | 17 620 | 13 650 | 10 350 |
| 178 | 10 | 25 | 26 250 | 18 750 | 14 250 | 10 870 | 8 250 |
| 182 | 13 | 3 | 73 500 | 43 650 | 29 100 | 20 770 | 15 450 |
| 183 | 13 | 6 | 51 750 | 31 870 | 22 500 | 17 250 | 12 900 |
| 184 | 13 | 10 | 41 020 | 26 400 | 19 500 | 15 000 | 11 400 |
| 185 | 13 | 13 | 34 500 | 22 500 | 16 870 | 13 120 | 9 900 |
| 187 | 13 | 25 | 20 620 | 13 870 | 10 120 | 7 870 | 6 370 |
| 194 | 16 | 13 | 29 400 | 19 120 | 13 500 | 10 500 | 8 250 |
| 196 | 16 | 25 | 17 620 | 11 620 | 8 100 | 6 150 | 5 100 |
| 200 | 20 | 3 | 50 930 | 33 520 | 23 850 | 17 850 | 13 350 |
| 201 | 20 | 6 | 38 250 | 24 370 | 17 400 | 13 270 | 9 970 |
| 202 | 20 | 10 | 30 600 | 19 500 | 13 500 | 10 120 | 7 800 |
| 203 | 20 | 13 | 25 500 | 15 900 | 10 870 | 8 250 | 6 600 |
| 204 | 20 | 20 | 18 900 | 12 000 | 84 000 | 66 220 | 5 250 |
| 215 | 25 | 3 | 38 200 | 24 900 | 18 000 | 13 870 | 10 500 |
| 216 | 25 | 6 | 30 520 | 18 600 | 12 750 | 9 520 | 7 500 |

**TABLE 2 MAXIMUM OPERATING SPEEDS FOR 6 mm MANDRELS FOR GROUP W PLAIN WHEELS**

( *Clause* 2.1 and *Fig.* 1 )

| Shape No. | Wheel Diameter mm | Wheel Thickness mm | 13 mm Overhang and Threaded Mandrels | 25 mm Overhang | 38 mm Overhang | 50 mm Overhang | 63 mm Overhang |
|---|---|---|---|---|---|---|---|
| | | | Maximum Operating Speed, m/s | | | | |
| 176 | 10 | 13 | 81 000 | 54 379 | 42 000 | 33 000 | 25 500 |
| 177 | 10 | 20 | 66 000 | 46 500 | 32 250 | 27 370 | 21 000 |
| 178 | 10 | 25 | 55 200 | 40 500 | 30 000 | 23 250 | 17 250 |
| 182 | 13 | 3 | 76 390 | 62 400 | 45 750 | 35 400 | 27 520 |
| 183 | 13 | 6 | 76 390 | 54 750 | 40 500 | 31 120 | 24 000 |
| 184 | 13 | 10 | 71 250 | 47 620 | 35 020 | 27 000 | 20 850 |
| 185 | 13 | 13 | 61 500 | 42 000 | 31 500 | 24 000 | 18 370 |
| 187 | 13 | 25 | 40 500 | 30 000 | 24 000 | 18 750 | 14 250 |
| 188 | 13 | 40 | 30 370 | 24 000 | 18 900 | 15 000 | — |
| 194 | 16 | 13 | 56 400 | 39 750 | 29 400 | 22 720 | 17 400 |
| 196 | 16 | 25 | 35 250 | 27 000 | 21 300 | 16 870 | 13 120 |
| 197 | 16 | 50 | 21 000 | 16 500 | 12 900 | 10 870 | — |
| 201 | 20 | 6 | 50 930 | 50 930 | 38 100 | 29 020 | 22 500 |
| 202 | 20 | 10 | 50 930 | 44 100 | 32 400 | 25 120 | 19 350 |
| 203 | 20 | 13 | 50 930 | 36 370 | 27 750 | 21 750 | 16 870 |
| 204 | 20 | 20 | 42 750 | 30 750 | 23 250 | 18 000 | 14 020 |
| 205 | 20 | 25 | 34 500 | 25 870 | 19 500 | 15 000 | 12 000 |
| 207 | 20 | 40 | 24 000 | 18 520 | 14 620 | 12 000 | — |
| 208 | 20 | 50 | 18 750 | 15 370 | 12 000 | 9 900 | — |
| 215 | 25 | 3 | 38 200 | 38 200 | 38 200 | 33 750 | 25 500 |
| 216 | 25 | 6 | 38 200 | 38 200 | 33 750 | 26 250 | 20 250 |
| 217 | 25 | 10 | 38 200 | 38 200 | 28 500 | 22 500 | 17 400 |
| 218 | 25 | 13 | 38 200 | 32 770 | 24 900 | 19 500 | 14 850 |
| 220 | 25 | 25 | 25 500 | 19 120 | 15 750 | 12 370 | 10 500 |
| 221 | 25 | 40 | 19 120 | 14 620 | 12 000 | 10 500 | — |
| 222 | 25 | 50 | 15 900 | 12 370 | 9 750 | 8 620 | — |
| 225 | 30 | 6 | 30 560 | 30 560 | 30 560 | 24 000 | 18 750 |
| 226 | 30 | 10 | 30 560 | 30 560 | 26 250 | 20 100 | 15 750 |
| 228 | 30 | 20 | 30 520 | 22 500 | 17 850 | 14 250 | 11 400 |
| 230 | 30 | 30 | 20 400 | 15 900 | 12 750 | 10 500 | — |
| 232 | 30 | 50 | 14 250 | 10 650 | 9 000 | 7 500 | — |
| 235 | 40 | 6 | 25 470 | 25 470 | 25 470 | 22 720 | 17 620 |
| 236 | 40 | 13 | 25 470 | 25 470 | 21 750 | 17 250 | 13 650 |
| 237 | 40 | 25 | 22 500 | 17 620 | 13 270 | 10 870 | 9 520 |
| 238 | 40 | 40 | 15 600 | 12 000 | 9 750 | 8 250 | — |

**3. Work Pressure** — Pressure between the wheel and the work shall at no time be so heavy that excessive springing of the mandrel will result.

Work pressure, if excessive, can be the cause of trouble and a source of danger through bending or fracture of the mandrel. If the wheel causes burning of the work of excessive reduction in mandrel speed it is quite likely that excessive pressure is being used. A freer cutting wheel specification may permit the desired rate of shock removal without excessive pressure.

**3.1** It is particularly important to observe this rule in connection with small wheel where the end of the mandrel that enters the wheel is of reduced diameter.

**4. Mandrel Material** — The material used for mandrels shall be such as to have a tensile strength of minimum 65 kg/mm$^2$.

## TABLE 3 MAXIMUM OPERATING SPEEDS FOR 3 mm MANDRELS FOR GROUP B SHAPED WHEELS

( *Clause* 2.1 )

| **Shape No.** | **Wheel Diameter** mm | **Wheel Thickness** mm | **13 mm Overhang and Threaded Mandrels** | **25 mm Overhang** | **40 mm Overhang** | **50 mm Overhang** | **63 mm Overhang** |
|---|---|---|---|---|---|---|---|
| | | | Maximum Operating Speed, m/s | | | | |
| 41 | 16·0 | 16 | 33 750 | 23 250 | 17 620 | 13 650 | 10 350 |
| 42 | 13·0 | 20 | 33 750 | 23 250 | 17 620 | 13 650 | 10 350 |
| 43 | 6·0 | 8 | 81 370 | 51 000 | 34 120 | 24 000 | 16 870 |
| 44 | 5·6 | 10 | 68 400 | 42 370 | 28 870 | 20 850 | 15 000 |
| 51 | 11·0 | 20 | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 52 | 10·0 | 20 | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 53 | 8·0 | 16 | 60 000 | 38 020 | 26 250 | 18 750 | 13 870 |
| 61 | 20·0 | 8 | 38 250 | 24 370 | 17 400 | 3 270 | 9 970 |
| 62 | 13·0 | 10 | 41 020 | 26 400 | 19 500 | 5 000 | 11 400 |
| 71 | 16·0 | 3 | 61 120 | 48 000 | 31 500 | 22 650 | 16 870 |
| 81 | 20·0 | 5 | 50 930 | 41 250 | 27 750 | 20 400 | 15 000 |
| 91 | 13·0 | 16 | 34 500 | 22 500 | 16 870 | 13 120 | 9 900 |
| 92 | 6·0 | 6 | 81 370 | 51 000 | 34 120 | 24 000 | 16 870 |
| 96 | 3·0 | 6 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 97 | 3·0 | 10 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 101 | 16·0 | 18 | 33 750 | 23 250 | 17 620 | 13 650 | 10 350 |
| 103 | 16·0 | 5 | 61 120 | 41 250 | 27 750 | 20 400 | 15 000 |
| 104 | 8·0 | 10 | 68 400 | 42 370 | 28 870 | 20 850 | 15 000 |
| 111 | 11·0 | 18 | 33 750 | 23 250 | 17 620 | 13 650 | 10 350 |
| 112 | 10·0 | 13 | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 115 | 2·5 | 3 | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 121 | 13·0 | — | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 122 | 10·0 | — | 61 650 | 37 720 | 27 000 | 19 870 | 14 250 |
| 123 | 5·0 | — | 104 250 | 61 820 | 44 620 | 30 900 | 20 250 |
| 124 | 3·0 | — | 105 000 | 64 500 | 46 650 | 32 400 | 21 370 |
| 131 | 13·0 | 13 | 34 500 | 22 500 | 16 870 | 13 120 | 9 900 |
| 132 | 10·0 | 13 | 45 370 | 28 500 | 21 000 | 15 900 | 12 150 |
| 133 | 10·0 | 10 | 54 000 | 33 000 | 24 150 | 18 000 | 13 500 |
| 135 | 6·0 | 13 | 60 000 | 38 020 | 26 250 | 18 750 | 13 870 |

### TABLE 4 MAXIMUM OPERATING SPEEDS FOR 6 mm MANDRELS FOR GROUP B SHAPED WHEELS

( *Clause* 2.1 )

| Shape No. | Wheel Diameter mm | Wheel Thickness mm | 13 mm Overhang and Threaded Mandrels | 25 mm Overhang | 38 mm Overhang | 50 mm Overhang | 63 mm Overhang |
|---|---|---|---|---|---|---|---|
| | | | Maximum Operating Speed, m/s | | | | |
| 41 | 16·0 | 16 | 61 120 | 46 500 | 35 250 | 27 370 | 21 000 |
| 42 | 13·0 | 20 | 61 120 | 46 500 | 35 250 | 27 370 | 21 000 |
| 51 | 11·0 | 20 | 81 000 | 54 370 | 42 000 | 33 000 | 25 500 |
| 52 | 10·0 | 20 | 81 000 | 54 370 | 42 000 | 33 000 | 25 500 |
| 61 | 20·0 | 8 | 50 930 | 50 930 | 38 100 | 29 020 | 22 500 |
| 62 | 13·0 | 10 | 71 250 | 47 620 | 35 020 | 27 000 | 20 850 |
| 71 | 16·0 | 3 | 61 120 | 61 120 | 48 000 | 37 500 | 29 020 |
| 91 | 13·0 | 16 | 61 500 | 42 000 | 31 500 | 24 000 | 18 370 |
| 101 | 16·0 | 18 | 61 120 | 46 500 | 35 250 | 27 370 | 21 000 |
| 102 | — | — | 61 120 | 54 320 | 42 000 | 33 000 | 25 500 |
| 111 | 11·0 | 18 | 66 000 | 46 500 | 35 250 | 27 370 | 21 000 |
| 112 | 10·0 | 13 | 81 000 | 54 370 | 42 000 | 33 000 | 25 500 |
| 121 | 13·0 | — | 76 390 | 54 370 | 42 000 | 33 000 | 25 500 |
| 131 | 13·0 | 13 | 61 500 | 42 000 | 31 500 | 24 000 | 18 370 |
| 132 | 10·0 | 13 | 81 000 | 54 370 | 42 000 | 33 000 | 25 500 |

### TABLE 5 MAXIMUM OPERATING SPEEDS FOR 6 mm MANDRELS FOR GROUP A SHAPED WHEELS

( *Clause* 2.1 and *Fig.* 1 )

| Shape No. | Wheel Diameter mm | Wheel Thickness mm | 13 mm Overhang and Threaded Mandrels | 25 mm Overhang | 38 mm Overhang | 50 mm Overhang | 63 mm Overhang | 75 mm Overhang |
|---|---|---|---|---|---|---|---|---|
| | | | Maximum Operating Speed, m/s | | | | | |
| 1 | 20 | 65 | 19 800 | 16 500 | 13 120 | 10 650 | 9 000 | 6 750 |
| 3 | 22 | 70 | 18 000 | 14 620 | 12 000 | 9 750 | 7 500 | 5 250 |
| 4 | 30 | 30 | 30 560 | 24 750 | 20 250 | 16 120 | 13 120 | 10 500 |
| 5 | 20 | 28 | 45 000 | 33 750 | 27 000 | 21 000 | 16 500 | 13 500 |
| 11 | 21 | 45 | 27 520 | 21 900 | 18 000 | 14 620 | 12 000 | 9 370 |
| 12 | 18 | 30 | 48 000 | 35 250 | 27 370 | 21 750 | 17 250 | 13 500 |
| 13 | 25 | 25 | 33 950 | 32 250 | 25 500 | 20 620 | 16 500 | 12 750 |
| 14 | 18 | 22 | 55 560 | 40 500 | 30 750 | 24 370 | 19 500 | 15 000 |
| 15 | 6 | 25 | 72 750 | 47 620 | 34 500 | 26 250 | 19 870 | 13 870 |
| 21 | 25 | 25 | 34 500 | 26 250 | 21 000 | 17 250 | 13 870 | 10 870 |
| 23 | 20 | 25 | 39 370 | 30 370 | 24 370 | 19 500 | 15 000 | 12 000 |
| 24 | 6 | 20 | 76 500 | 49 500 | 36 370 | 27 000 | 20 250 | 15 370 |
| 25 | 25 | 25 | 35 620 | 27 370 | 22 120 | 18 000 | 14 250 | 11 250 |
| 26 | 16 | 16 | 61 120 | 46 500 | 35 250 | 27 750 | 21 370 | 15 750 |
| 31 | 35 | 26 | 27 780 | 26 250 | 21 000 | 17 250 | 13 500 | 10 870 |
| 32 | 25 | 20 | 38 200 | 38 200 | 30 000 | 24 000 | 18 900 | 15 000 |
| 34 | 38 | 10 | 25 470 | 25 470 | 25 470 | 21 970 | 18 000 | 13 870 |
| 35 | 25 | 10 | 38 200 | 38 200 | 31 500 | 25 500 | 20 250 | 15 900 |
| 36 | 40 | 10 | 23 520 | 23 520 | 23 520 | 21 750 | 17 620 | 13 870 |
| 37 | 30 | 6 | 30 560 | 30 560 | 30 560 | 28 100 | 22 500 | 18 000 |
| 38 | 25 | 25 | 34 500 | 26 250 | 21 000 | 17 020 | 13 500 | 10 650 |
| 39 | 20 | 20 | 47 250 | 35 250 | 27 750 | 22 120 | 17 250 | 13 120 |

### TABLE 6 SPECIAL MAXIMUM OPERATING SPEEDS FOR MOUNTED WHEELS

( *Clause* 2.2 )

| **Outside Diameter of Wheel** *mm* | **Maximum Speed** rev/min |
|---|---|
| (1) | (2) |
| 6 | 152 800 |
| 8 | 122 200 |
| 9 | 101 900 |
| 11 | 87 310 |
| 13 | 76 390 |
| 16 | 61 120 |
| 18 | 55 560 |
| 20 | 50 930 |
| 21 | 47 010 |
| 22 | 43 650 |
| 24 | 40 740 |
| 25 | 38 200 |
| 28 | 33 950 |
| 31 | 30 560 |
| 34 | 27 780 |
| 38 | 25 470 |
| 41 | 23 520 |
| 45 | 21 830 |
| 50 | 19 100 |

# EXPLANATORY NOTE

The safe operation of abrasive wheels requires the understanding and cooperation of many diverse groups and of all individuals concerned with their use or operation. This has been the basic viewpoint in establishing these safety requirements for the guidance of manufacturers, users and others involved in handling these products.

A thorough knowledge of nature and characteristics of abrasive wheels, the grinding machines on which they are used and the safety and protection devices which can and shall be used to limit, if not eliminate, injury or damage in case of accidental wheel breakage, is necessary for proper understanding of these safety requirements. These safety requirements may be used as a guide and not as an alternative to constant educational programmes at all levels which are the best insurance against those unforeseen conditions or circumstances which result in an industrial accident.

The mandatory requirements are printed in normal ( 10 points ) type and the explanatory information in smaller ( 8 point ) type. This is intended to facilitate a condensed document of mandatory requirements together with supporting tables and a figure. The explanatory information gives the basic reasons for the rules to encourage their implementation in practice. However, it may not be termed as part of the standard. The explanatory material has been included to encourage compliance and it is given only where it amplifies or clarifies a requirement.

Operating rules are not included in these safety requirements unless they are of such a nature as to be important safety requirements equal in importance to other requirements included in this standard.

This standard was first issued in 1962 and its first revision was taken up in 1973, based on ANSI B 7.1-1970.

In order to review the individual section at any time and also for technical and drafting reasons alike, this standard has been split-up in the following ten parts:

Part 1 Scope and definitions
Part 2 Handling and storage
Part 3 General machine requirements
Part 4 Safety guards
Part 5 Flanges
Part 6 Inspection and mounting
Part 7 Standard speeds
Part 8 Special speeds
Part 9 General operating rules
Part 10 Mounted wheels

While splitting, this part ( Part 10 ) of the standard has also been revised and the details have been made more explicit. More data has also been included.

While revising this standard, assistance has also been taken from the following publications:

> 'European safety requirement for the use, care and protection of abrasive wheels', issued by the Federation of European Producers of Abrasive Products ( FEPA ).
>
> ANSI B 7.1-1978 'Safety requirement for the use, care and protection of abrasive wheels', issued by the American National Standards Institute, USA.

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